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장시간 근로가 배우자의 심혈관질환 발생에 미치는 교차효과분석

Crossover effect of spouse weekly working hours on estimated 10-years risk of cardiovascular disease

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Abstract

Crossover effect of spouse weekly working hours on estimated 10-years risk of cardiovascular disease

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Objectives: To investigate the association between spouse weekly working hours (SWWH) and the estimated 10-years risk of cardiovascular disease (CVD).

Methods: This cross-sectional study was based on the data obtained from the Korean National Health and Nutrition Examination Survey 2007–2012. Data of 20,739 participants (10,030 husbands, 10,709 wives) were used for this analysis. The participants' clinical data were collected to estimate the 10-years risk of CVD, as well as weekly working hours. Multiple logistic regression was conducted to investigate the association between SWWH and the estimated 10-years risk of CVD. Stratified analysis was also performed according to employment status of the participants and their spouses.

Results: Compared to the participants whose spouses worked 40 hours per week, estimated 10-years risk of CVD was significantly higher as SWWH increase among those whose spouses worked >40 hours per week. After adjusting for covariates, the odds ratio for high CVD risk was found to increase as SWWH increased, up to 1.90 among husbands and 2.24 among wives. It was also found that the association between SWWH and the estimated 10-years risk of CVD varied according to the employment status. Analysis of each component included in the CVD appraisal model showed that SWWH had close relationship with diabetes in men, and smoking habits in women.

Conclusions: Spouse's long working hours are associated with individual's risk of CVD in future, especially among husbands.

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Key words: Cardiovascular disease, Working hours, Spouse, Crossover effect

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INTRODUCTION

There is sufficient evidence to prove the association between individual's long working hours and the incidences of mental and physical health problems, such as hypertension, musculoskeletal discomfort, diabetes, occupational injury, increased suicide rate, sleep problems, preterm birth, poor psychological health, and unhealthy lifestyle conditions [1,2].

Working hours may affect health in a variety of ways, either directly or indirectly [4]. First, incomplete physical recovery is an important pathway to chronic health impairment. Another important pathway is that long working hours are likely to coincide with high job demands. Third, work-family life imbalance may be one of the most important links between long working hours and adverse health effects. People who work long hours may be unhappy with their work-life balance and may experience that their working patterns have a negative impact on their domestic relationships. Long working hours can contribute to the double burden of paid and domestic work. In a prospective cohort study done on full-time municipal employees, higher rates of sickness-related absences, psychological distress, and poor health were observed among those who experience severe work-family conflict than those who did not have such experiences [5]. Golden and Wiens-Tuers also suggested that the adverse effects of long working hours, such as fatigue, work stress, and work-family interference, were not offset by higher income [6].

Until a recent date, few studies have concentrated on the possible effect of

working hours on the spouse, the person with whom the worker most frequently interacts. A large body of studies in the area of occupational psychology has shown that poor working conditions can worsen employees' family life [3].Moreover, it has been reported that workplace stress and strain affect not only the person's own health but are transmitted to their partners as well, both in terms of mental and physical health.

Further research, pertaining to the dyadic nature of stress crossover to the spouse, is required, because they might cause adverse reciprocal effects between the couples, leading to a spiral loss of resource and impaired functionality [7]. In recent times, there has been an increase in the number of studies that have focused on the crossover effect between couples, concerning depression [8], burnout [9], physical health [10], negative moods [11], and daily happiness [12]. However, most of these studies have assessed relatively small and specific occupational groups or have used data collected from Western populations. Moreover, as far as we know, there is no direct evidence supporting the theory that working overtime can affect a spouse's future risk of CVD, although the association between cardiovascular disease (CVD) and long working hours has been investigated in several studies [1,2].

In our study, we investigated the crossover effect of long working hours on Korean couples, particularly in terms of cardiovascular health. The primary purpose of this study was to investigate the relationship between the spouse working hours and estimated 10-years risk of CVD, using representative data from a national population-based survey in Korea. In addition, identifying the

characteristics to modify this relationship would be helpful for the development of strategies to prevent CVD of workers. Therefore, we also examined how this relationship is modified by gender and employment status.

SUBJECTS AND METHODS

Study Design and Participants

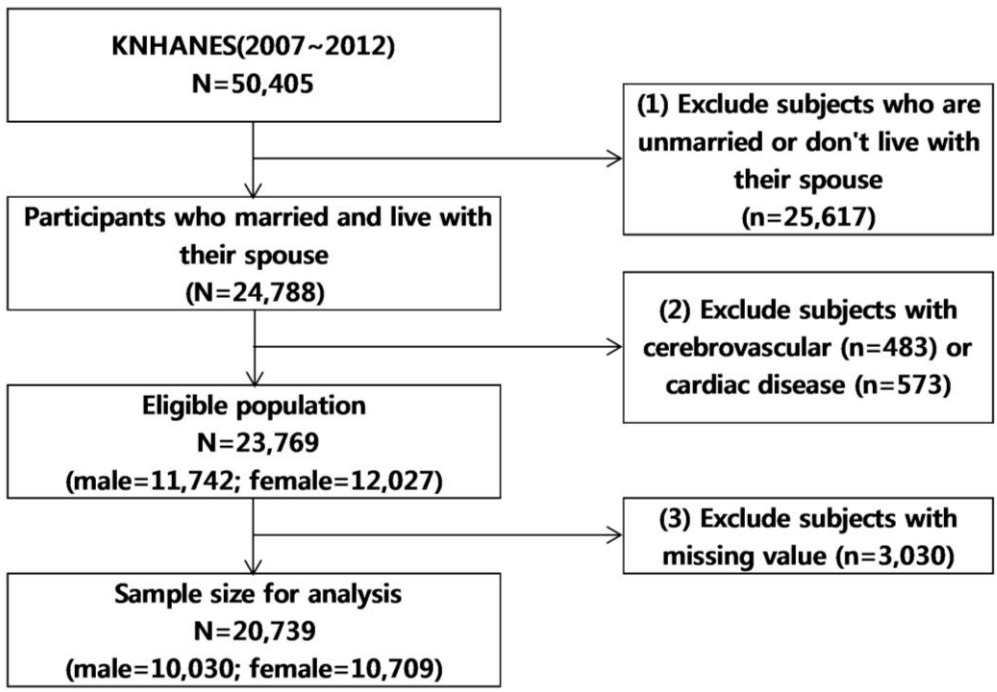
In this study, we utilized data from the Korean National Health and Nutrition Examination Survey (KNHANES). The KNHANES has been conducted by the Korea Center for Disease Control and Prevention (KCDC) since 1998. The KCDC conducted the 4th KNHANES from 2007 to 2009 and the 5th KNHANES from 2010 to 2012. These yearly data are available in the KNHANES website (http://knhanes.cdc.go.kr). Multistage probability sampling was used, stratified by geographic location, sex, and age. The original study was approved by the Institutional Review Board (IRB) of the KCDC (IRB: 2007-02-CON-04-P; 2008-04EXP-01-C; 2009-01CON-03-2C; 2010-02CON-21-C; 2011-02CON-06-C; 2012-01EXP-01-2C).

At the time of the KNHANES 2007-2012, citizens were informed that they had been randomly selected as a household to voluntarily participate in the nationally representative survey conducted by the Korean Ministry of Health and Welfare. All participants of the KNHANES provided written informed consent. The KNHANES collected information on the participants' socioeconomic status, and the participants underwent anthropometric measurements, a health interview, a physical examination, and a nutrition survey, through the face-to-face interview.

In total, 50,405 individuals (24,871 and 25,534 individuals from the 4th and the 5th KNHANES, respectively) participated in the surveys. Because sampling units of

KNHANES were households, couples were matched with their household identification numbers. For our analysis, we included participants who were married and lived with their spouse during the KNHANES (n = 24,788). After excluding participants with cerebrovascular disease (n = 483) or cardiac disease (n = 573), 23,769 participants (11,742 men, 12,027 women) were eligible for participation. The final sample for analysis included 20,739 participants (10,030 husbands, 10,709 wives), after further excluding participants with missing values (n=3,030) (Figure 1).

FIGURE 1. Schematic diagram depicting study population.



Measurements

The KNHANES included questions pertaining to a wide array of characteristics. Trained staff members reviewed the completed questionnaires and entered them into a database. We used the variables for age, sex, occupation, medical history, and smoking habit. Occupations were classified into 7 groups: 'Managers and professionals', 'Office workers', 'Service and sales workers', 'Agriculture, forestry and fishery workers', 'Craft, device machine operators and assembly workers', 'Manual workers', and 'Unemployed'. Weekly working hours were measured as the actual number of hours the respondent worked per week across all paid jobs.

We defined the non-smoker was those who had either never smoked or were ex-smokers. Participants' blood pressure was measured in the right arm at heart level using a standard mercury sphygmomanometer (Baumanometer, USA) while they were seated and after they had rested for at least 5 min. The average of two measured value each for systolic blood pressure (SBP) and diastolic blood pressure (DBP), which were measured at an interval of 5 min, was used for analysis. After fasting 12-hr overnight, blood samples were obtained from an antecubital vein. Total cholesterol and high-density lipoprotein (HDL) cholesterol were measured using an autoanalyzer (ADVIA 16501, Bayer, Tarrytown, NY, USA).

The individual's risk for CVD was determined using a health risk appraisal model for coronary heart disease, which was based on data collected nationwide from the Korean Heart Study including 430,920 individuals (266,782 men and 164,138 women) combined with National Health Insurance System [13]. This model was developed based on the multivariate Cox proportional hazard model using a

retrospective cohort data in the same manner as in the Framingham equation model [14]. It was known that Framingham equation model overestimates the risk of ischemic heart disease in the Asian population [15]. To overcome the limitation of the Framingham equation model in Korean populations, Jee et al. developed an individualized health risk-appraisal model for ischemic heart disease. They applied split-half method that the first half of data was used for developing a model and the rest was used for testing for validity of the model. This health-appraisal model accurately predicted the actual rates of events [16,17]. The actual ischemic heart disease event rates were similar to the event rates predicted by the Korean risk prediction model for ischemic heart disease [18].

The first step in estimating the future risk of CVD was to calculate the score for each risk factor and then an individual's 10-year risk was computed using cardiovascular risk functions specific to Korean men and women. Assessment of global risk of CVD based on the summation of categorical values of major risk factors: age, sex, total cholesterol, high-density lipoprotein (HDL) cholesterol, blood pressure, diabetes, and smoking. Next, participants were stratified into two groups: high-risk group and low-risk group. We defined the predicted risk of fatal and non-fatal CVD events of 90^{th} percentile or greater by gender as the threshold for high risk among study population.

Statistical Analysis

The general characteristics of the study population (10,030 men, 10,709 women) were described using mean (± standard deviation) or frequencies and percentages.

The means of estimated 10-years risk of CVD was calculated by spouse weekly working hours (SWWH) and employment status of both partners. After excluding subjects who lack information about SWWH (spouse's unemployment or missing value), 12,991 subjects (4,820 husbands, 8,171 wives) stratified into high and low CVD risk were categorized by SWWH. Multiple logistic regression analyses were used to evaluate relationships between high CVD risk and SWWH categories according to sex, adjusting for household income level, employment status, education level, and spouse occupation categories. Given that the results could be affected by gender and employment status of both partners, we performed stratified analysis according to each participant and the spouse employment status, using entire analytic population (10,030 men, 10,709 women) except for subjects with missing value .

The numbers of subjects were different between eligible population and analytic population across the tables. This was due to dyadic property of our study. For example, there were cases in which analysis of wife was possible, but the analysis of the husbands was not possible due to a lack of information on wife's working hour while we had the information for husbands. Moreover, 1,496 subjects (701 husbands, 795 wives) were not used in main analysis because of missing value about estimated 10-years risk of CVD, despite the presence of information on SWWH. Since 10-years risk of CVD was estimated by combining six risk factors, participants had to be excluded from the final analytic models even when only one value was missing. So, we conducted additional analyses including 1,478 subjects, in which the missing values were treated using multiple imputation technique [19].

We also analyzed each component included in CVD appraisal model by SWWH categories.

Two-tailed p-values <0.05 were considered statistically significant. Statistical analyses were performed using SURVEYREG and SURVEYLOGISTIC in SAS (ver. 9.3, SAS Institute, Cary, NC, USA), a software package that account for the complex sample design. Survey sample weights were used in all analyses to produce estimates that were representative of the Korean population. Figures were drawn by using a generalized additive model (GAM) of R version 3.2.4.

RESULTS

Mean ages of the male and female participants were 51.8 (± 13.5) and 48.7 (± 12.9) years, respectively. The levels of total cholesterol were similar between men and women, but HDL levels were slightly lower in male participants than in female participants. The other risk factors for CVD such as high blood pressure, diabetes mellitus, and current smoking, were higher in the male participants than for the female participants. The proportion of each sex that was unemployed was 17.1% in men and 50.0% in women. The largest percentage of participants worked 41–59 hours per week for men, and <30 hours for women. The descriptive characteristics of the study population are summarized in Table 1.

TABLE 1. Demographic and clinical characteristics of study populations

	Male		Female	
	Mean	**SD**	**Mean**	**SD**
Age	51.8	13.5	48.7	12.9
Total cholesterol (mg/dl)	190.4	34.9	190.7	36.6
HDL cholesterol (mg/dl)	48.0	11.9	53.7	12.8
SBP (mmHg)	121.6	15.9	115.8	17.4
DBP (mmHg)	79.5	10.7	74.2	10.0
	n	**%**	**n**	**%**
Diabetes				
Yes	1146	11.9	712	7.2
No	8496	88.1	9110	92.8
Smoking				
Non-smoker	1643	16.7	9575	92.2
Ex-smoker	4259	42.2	465	4.5
Current smoker	4157	41.2	348	3.4
Occupation				
Managers and professionals	1828	18.1	897	8.6
Office workers	1222	12.1	614	5.9
Service and sales workers	1195	11.8	1470	14.1
Agriculture, Forestry and Fisheries Workers	1189	11.8	952	9.2
Craft, device machine operators and assembly workers	2189	21.6	316	3.0
Manual workers	758	7.5	949	9.1
Unemployed	1734	17.1	5195	50.0
Working Hours				
<30	818	9.7	1191	23.1
30-39	733	8.7	812	15.7
40	1445	17.2	724	14.0
41-49	1635	19.4	862	16.7
50-59	1636	19.5	623	12.0
60-69	1086	12.9	409	7.8
70-79	668	7.9	332	6.4
≥80	389	4.6	210	4.1
Total	10,030		10,709	

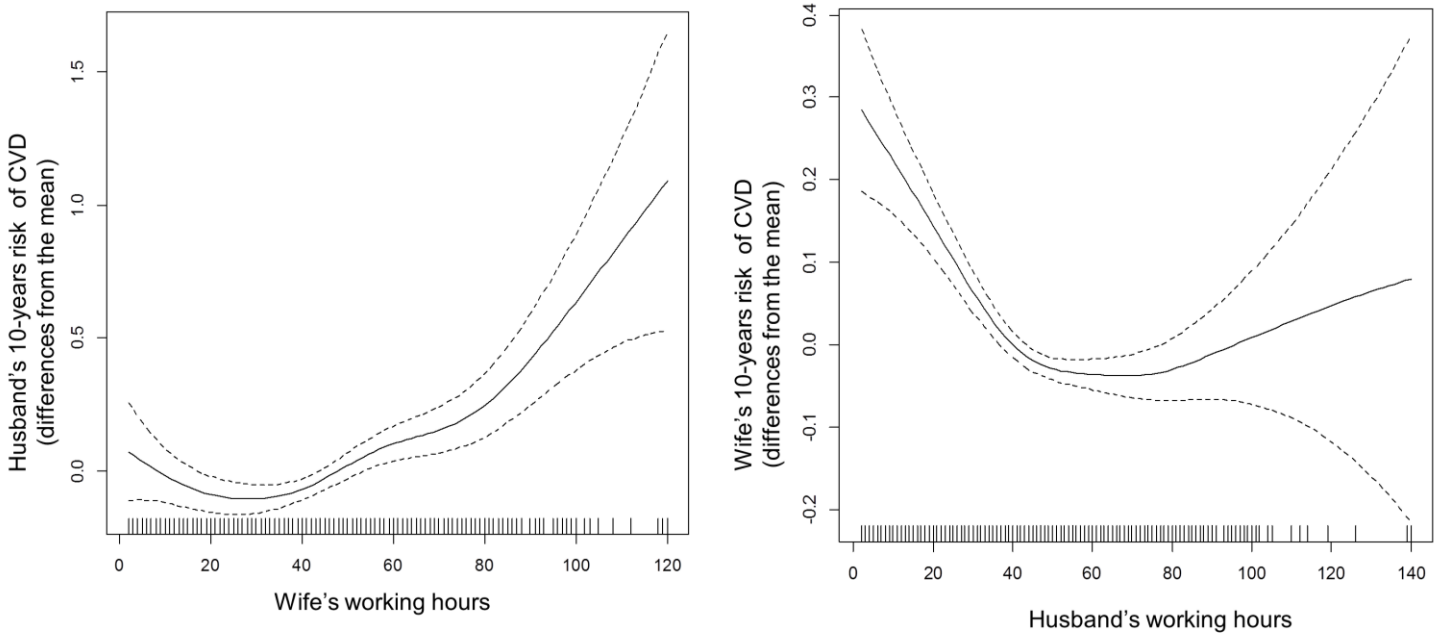
After excluding subjects without information on SWWH, estimated 10-years risk of CVD for 4,820 husbands and 8,171 wives are presented according to SWWH in Table 2. The lowest risk of CVD was observed in the 40 SWWH group for both men and women. Generally, 10-years risk of CVD increased as the SWWH increased from 40 hours in both genders. In the same manner, the probability of being a high-risk group for CVD increased as the SWWH increased, after adjusting for household income level, employment status, education level, and spouse occupational category. Moreover, the results showed a dose-response relationship, suggesting that the longer a spouse worked, the more likely individual became a high risk group for CVD (≥80 hours, men, OR = 1.90; women, OR=2.24). It was also observed that subjects whose spouse worked < 40 hours showed higher values than those whose spouse worked 40 hours. Figure 2 displays that the overall risk of CVD was increased as the SWWH increased or decreased from 40 hours in both genders, and the association between increasing SWWH and estimated 10-years risk of CVD was more remarkable in men (see also S1 Table, Supplementary Figure).

TABLE 2. 10-years risk of CVD estimated by Jee's health risk appraisal model according to spouses' working hour categories.

	Spouse's Working Hours	N	Estimated 10-years risk		≥ 90 percentile of estimated risk of cardiovascular disease			
			Mean	SD	N	%	OR*	95% CI
Husband's 10-year Risk of CVD According Wife's Working Hour Categories	<30	1092	1.73	1.71	96	8.79	1.32	0.83-2.09
	30-39	746	1.66	1.58	58	7.77	1.29	0.79-2.11
	40	682	1.24	1.20	28	4.11	1	Reference
	41-49	811	1.61	1.58	65	8.01	1.64	1.15-2.65
	50-59	593	1.74	1.44	46	7.76	1.16	0.69-1.94
	60-69	390	2.05	1.93	45	11.54	1.71	1.02-2.89
	70-79	311	1.81	1.29	23	7.40	1.13	0.62-2.07
	≥80	195	2.13	1.69	22	11.28	1.90	1.03-3.51
	Total	4820	1.74	1.75	383	7.95		
Wife's 10-year Risk of CVD According husband's Working Hour Categories	<30	770	0.87	1.01	155	20.13	3.88	2.42-6.21
	30-39	713	0.51	0.74	67	9.40	2.41	1.45-4.03
	40	1412	0.24	0.36	26	1.84	1	Reference
	41-49	1590	0.30	0.57	67	4.21	1.69	1.03-2.78
	50-59	1601	0.31	0.59	60	3.75	1.45	0.87-2.41
	60-69	1064	0.32	0.48	51	4.79	1.80	1.07-3.02
	70-79	651	0.42	0.88	34	5.22	1.67	0.95-2.94
	≥80	370	0.41	0.63	25	6.76	2.24	1.19-4.19
	Total	8171	0.52	0.83	485	5.94		

*adjusted for household income level, education level, employment status and spouse occupation categories

FIGURE 2. Generalized additive model of spouse's working hours and estimated 10-years risk of CVD. 10-years risk of CVD was estimated by Jee's health risk appraisal model. The values of Y-axis indicate differences from the means. Household income level, education level, and spouse occupational category are adjusted.



We found that the association between SWWH and the estimated 10-years risk of CVD varied according to the couple's employment status (Tables 3 and 4) as well. In general, unemployed men had more than a 2-fold higher risk of CVD within 10 years than employed men (estimated 10-years risk for CVD, employed men =1.43; unemployed men=3.27) (Table 3). When their wives were unemployed, employed husbands' 10-year risk of CVD was 1.31% and unemployed husbands' risk was 3.46%. A dose-response relationship between wives' working hours and estimated 10-years risk of CVD was observed only among employed husbands (p for trend<0.001), but not among unemployed husbands. In contrast, association between SWWH and the CVD risk of wives did not significantly differ by their spouses' employment status (Table 4). A thought-provoking finding to emerge from the data comparison was that the highest risk was observed when both wife and husband were unemployed (male, 10-year risk=3.46%; female, 10-year risk=1.35%).

TABLE 3. Husband's 10-years risk of CVD estimated by Jee's health risk appraisal model according to their own employment status and wife's working hour categories

Husband's Employment status	Wife's Working Hours	N	Estimated 10-years risk		≥ 90 percentile of estimated risk of cardiovascular disease			
			Mean	SD	N	%	OR	95% CI
Employed[a]	Unemployed[c]	3711	1.31	1.39	197	5.31	1.37	0.86-2.21
	<30	946	1.49	1.43	55	5.81	1.01	0.59-1.60
	30-39	667	1.51	1.41	41	6.15	1.19	0.68-2.09
	40	629	1.14	1.09	21	3.34	1	Reference
	41-49	728	1.48	1.38	45	6.18	1.42	0.82 -2.47
	50-59	525	1.65	1.39	36	6.86	1.36	0.76-2.41
	60-69	343	1.85	1.73	28	8.16	1.36	0.74-2.53
	70-79	283	1.71	1.20	16	5.65	1.04	0.51-2.10
	≥80	166	1.97	1.57	13	7.83	1.75	0.83-3.72
	Total	8338	1.43	1.41	452	5.65		
Unemployed[b]	Unemployed[d]	1043	3.46	2.44	338	32.41	3.16	1.40-7.15
	<30	144	3.32	2.41	41	28.47	2.16	0.89-5.26
	30-39	76	2.99	2.22	17	22.37	1.49	0.55-4.03
	40	53	2.46	1.67	7	13.21	1	Reference
	41-49	83	2.82	2.42	20	24.10	2.27	0.87-5.92
	50-59	67	2.46	1.61	10	14.93	0.90	0.31-2.64
	60-69	47	3.51	2.61	17	36.17	3.37	1.22-9.29
	70-79	28	2.89	1.65	7	25.00	2.17	0.66-7.18
	≥80	29	3.00	1.66	9	31.03	3.34	1.06-10.48
	Total	1692	3.27	2.24	466	29.68		

[a]adjusted for household income level, education level, spouse occupation categories, and own weekly working hours
[b]adjusted for household income level, education level, spouse occupation categories, but not own weekly working hours
[c]adjusted for household income level, education level, own weekly working hours but not spouse occupation categories
[d]adjusted for household income level, education level, but not own weekly working hours or spouse occupation categories

TABLE 4. Wife's 10-years risk of CVD estimated by Jee's health risk appraisal model according to their own employment status and husband's working hour categories

Wife's Employment status	Husband's Working Hours	N	Estimated 10-year risk		≥ 90 percentile of estimated risk of cardiovascular disease			
			Mean	SD	N	%	OR	95% CI
Employed[a]	Unemployed[c]	548	0.88	1.00	107	19.53	1.87	1.85-1.88
	<30	427	0.79	0.88	75	17.56	1.66	1.65-1.68
	30-39	395	0.50	0.63	37	9.37	1.44	1.42-1.45
	40	678	0.22	0.32	10	1.47	1	Reference
	41-49	831	0.32	0.61	35	4.21	1.05	1.04-1.05
	50-59	828	0.36	0.59	36	4.35	0.98	0.98-1.00
	60-69	576	0.37	0.52	39	6.77	1.47	1.46-1.49
	70-79	396	0.40	0.50	21	5.30	1.07	1.05-1.08
	≥80	248	0.43	0.65	16	6.45	1.38	1.36-1.40
	Total	5347	0.45	0.68	376	7.63		
Unemployed[b]	Unemployed[d]	1063	1.35	1.21	361	33.96	7.77	4.46-13.53
	<30	342	0.98	1.15	80	23.39	3.41	1.66-7.00
	30-39	318	0.53	0.85	30	9.43	2.72	1.27-5.84
	40	731	0.25	0.39	16	2.19	1	Reference
	41-49	756	0.29	0.52	32	4.23	2.01	0.95-4.28
	50-59	767	0.25	0.59	22	2.87	1.73	0.81-3.67
	60-69	486	0.25	0.40	12	2.47	2.79	1.32-5.90
	70-79	253	0.44	1.26	13	5.14	1.84	0.82-4.16
	≥80	121	0.36	0.58	9	7.44	2.42	1.01-5.78
	Total	5362	0.58	0.95	575	11.89		

[a]adjusted for household income level, education level, spouse occupation categories, and own weekly working hours
[b]adjusted for household income level, education level, spouse occupation categories, but not own weekly working hours
[c]adjusted for household income level, education level, own weekly working hours but not spouse occupation categories
[d]adjusted for household income level, education level, but not own weekly working hours or spouse occupation categories

DISCUSSION

The first main finding of the present study was that there was a close relationship between SWWH and estimated 10-years risk of CVD. This was particularly marked in the male participants of this study. These findings suggest that when an individual works overtime, it negatively affects not only his/her cardiovascular system, but also that of his/her spouse. Furthermore, the results of our study showed that couple's employment status might modify the effects of SWWH on the risk of CVD.

Various terms have been used to describe this phenomenon: carryover, contagion of stress, stress transmission, and stress transference. In recent decades, the term 'crossover' has been used more commonly [20]. Previous studies have identified two different ways in which stress is transferred: spillover and crossover. While spillover effect is a transmission of strain from one domain of life to another within a person [21], the crossover effect involves the transmission of stress and strain from an individual to his/her spouse [22]. Taken together, stress that originates in the workplace may spill over to the family domain, which, in turn, transmit to a spouse by crossover effect [21]. As a result, a person's long working hours can lead to his or her spouse' cardiac health problems through this sequential transmission of stress. In a study among Japanese dual-earner couples, it was reported that dual experiences of work-to-family conflict have a detrimental effect on the health of workers and the relationship between partners [23]. Matthews et al.

also examined crossover effects in dual-earner couples. The results indicated that a worker's work-to-relationship conflict and the perception of partner's work-to-family conflict were associated with the worker's as well as partner's outcomes, such as tension of relationship, health symptoms, and the satisfaction in the relationship [24]. More recently, Kramer and Chung reported relationship between spouse work hours and BMI growth over time in dual-earners families [25] . Drawing on Conservation of Resources theory, authors proposed that an increase in demands—both in the work realm (e.g., the number of work hours) and in the family realm (e.g., the number of spouse work hours)—is likely to speed up the increase of BMI.

Three possible mechanisms have been suggested to explain the crossover process [22]. First, the direct transmission of strain, where one's strain produces an empathetic reaction in the other spouse, increasing his/her level of strain. Since spouses spend considerable time together, they may pay close attention to, and be affected by others' emotional states. Second, spouses may share some common stressors (e.g., financial pressures, life events) that can affect both members of the dyad simultaneously. Third, crossover effect may occur through an indirect process in which the transmission of strain be mediated by negative social interactions and communication (e.g., social undermining and lack of social support).

The direct crossover of stressors/strains is generally explained via empathy. Crossover can occur when stressors/strains experienced by one partner produce an empathic reaction in the other partner, which in turn increase the partner's level of stressors/strains as a result of the intimate nature of their relationship. Individuals

in a close relationship tend to care for each other and are likely to be influenced by the emotional states of their spouses. This psychological intimacy produces an empathetic response, a form of relationship-focused coping with stress of one's spouse [26]. An experimental study on teachers, though not using couples, found that when teachers talked frequently with colleagues, about their burnout, the crossover of burnout from the teachers to their fellow teachers was observed to occur through this mechanism [27]. Other empirical studies on dual-earner couples have supported the occurrence of the direct process where stress and strain directly crosses over from one spouse to the other, such as the transfer of psychological distress [28], perceived health [10], exhaustion [29], and burnout [30].

In current study, an individual's perceived stress level was significantly correlated with spouse's perceived stress level in both male and female subjects (male, β=0.1085, p value<0.001; female, β=0.1089, p value<0.001). These results can be explained by direct transmission of strain. Perceived stress transmitted from the spouse can activate an individual's hypothalamic pituitary adrenal (HPA) axis. Activation of inadequate or excessive adrenocortical and autonomic function can cause deleterious effect on health. Repetti et al. reported that husbands had elevated levels of cortisol, which is a stress hormone, at home after socially stressful days at work, consistent with a physiological spillover effect [31]. In a 3-day study of couples, it was found that husbands' and wives' fluctuations in negative mood and cortisol levels were linked [32]. When we constructed analytic model adding individual's perceived stress level, estimation of risk became slightly reduced, but contrary to what we expected, it was not significant difference (S2 Table). That

may be because life style or family role in the home domain could also affect the stress response and eventually process of CVD development, but we could not take it into account because of lack of information regarding origin of strain (from work or family domain). Poor self-esteem or the threshold of each individual coping with the stress may act as a key factor as well [33].

The second mechanism, the common stressors explanation of crossover, hypothesizes that the relationship between one partner's stressors and the other partner's strains may be derived from common stressors experienced in a shared environment (such as financial difficulties, etc.) and negative life events (such as a sick child, unemployment, etc.). For example, an individual's unemployment may influence both spouses' health through this mechanism [28]. Our finding that unemployment of both spouses increased the risk of CVD might be explained by common stressors which the couples share [22,29] (Tables 3 and 4). This finding supports the idea that couples' financial hardship can affect the perceived health status in both spouses [10]. In this context, unemployment does not merely mean being zero working hour, but it might imply different aspects, such as financial problems, poor self-efficacy, and loss of social network. It is possible that income reduction due to unemployment is an important factor that affects the cardiac health of a person and their spouse. Moreover, the job loss of the head of household under the incomplete social welfare system and little family property is a significant stress factor to family members, particularly to the spouse.

The third crossover mechanism is characterized as an indirect process in which various aspects of the nature of the dyad's interaction are considered responsible

for crossover effects. In other words, the manner of a couple's interaction plays a key role in this crossover process. The mediating role of two types of interpersonal interactions, as proposed by Westman (2001), has been empirically tested: *spousal undermining* and *spousal social support.*

Social undermining refers to a poor relationship between a husband and wife. According to Vinokur and van Ryn, social undermining consists of behaviours directed toward the target person, which express (a) negative affect; (b) negative evaluation of the person in terms of his/her attributes, actions, and efforts (criticism); and (c) behaviours that compromise or hinder the attainment of instrumental goals [34]. Westman and Vinokur supported the mediating role of social undermining in the crossover process. Women's depression in both the waves of their longitudinal study was found to increase their undermining behaviours towards their husbands, which in turn increased their husbands' depressive symptoms. Their results suggested that the correlation in the depression symptoms in couples was primarily due to crossover via negative social interaction [35].

Social support has also been proposed as a central feature in crossover research. Social support is often conceptualized as 'social interactions or relationships that provide individuals with actual assistance or with a feeling of attachment to a person or group that is perceived as caring or loving [36]. The Conservation of Resources theory posits that strained individuals seek to maintain and accumulate resources [37]. Thus, when individuals are threatened with resource loss, actually lose resources, or fail to gain resources following resource investment, their

performance in providing emotional support to their partner will suffer. Similarly, stressed individuals may simply be less capable of giving sufficient support and restricting themselves from undermining behaviours [38]. Empirical evidence supports that social support acts as a buffer and protects against the development of depression or anxiety in the face of poor working conditions [39].

In our study, the male participants worked for an average of 48.7 (± 17.3) hours, while female participants worked for 42.5 (± 19.7) hours. We found that 45.4% (n = 3,420) of the men and 31.6% (n = 1,447) of the women worked for ≥50 hours per week. When we conducted a paired analysis according to both participant's own weekly working hours and SWWH, it was evident that the SWWH has a significant relationship with increased risk of CVD as SWWH increased from 40 hours, regardless of their own working hours (S3 Table). Remarkably, the association between SWWH and the risk of CVD was more prominent in husbands, especially in case of increasing SWWH. The figures drawn by using GAM showed that the slope of husband's CVD risk was steeper than that of wife's, as SWWH increased (Fig 2, Supplementary Fig). These findings are consistent with those of previous studies [40,41]. Most research regarding the crossover of stress between spouses takes gender differences into account.

The traditional expectations for gender roles play an important role in understanding the work-family conflicts across diverse cultures. The traditional gender role stereotypes assume that husbands as breadwinners are primarily responsible for family income and therefore have a greater value on the work domain, while wives are expected to take on more responsibility for family

demands. East Asian culture, especially, encourages husbands to devote more time to the job to maximize the economic benefits for the family. East Asians are likely to evaluate work and economic gain from the perspective of the family, rather than at the individual level, because daily life in these countries is influenced by a collectivistic cultural value [42] and the family-based philosophical traditions of Confucianism [43]. According to this family-based work ethic, husbands' overtime work and temporary sacrifice of the family life would be perceived as 'normal' and acceptable by the family members; however, they tend to have a lower threshold of acceptance for wives' long working hours [42]. Our finding, that employed husbands whose wives were unemployed or worked less hours have a decreased risk of CVD, is consistent with the traditional gender role expectations (Table 3).

Economic pressures are forcing women to take a more active role outside the home and to pursue full-time careers in Korea [44]. Women are increasingly being forced to deal with rising expectations and job demands that limit their performance related to family roles. Similarly, men are becoming more involved with their families, and their priorities may even be shifting away from work. The increasing participation of women in the workforce, and a greater number of dual-earner families, has made traditional approaches to coordinating work and family lives inappropriate. Although the distinction of cultural gender roles has become ambiguous due to the increased economic activity of women, the women in Korea still fulfill cultural gender roles, in general. Together, these trends result in the potential for interference or conflicts between career women's work and non-work lives. Spitze (1988) offered interesting insights into the possible consequences of

women's engagement in work on other family members' physical health [40]. Career women might have more money to pay for care, but less time available to provide physical care. Indeed, wife's long working hours might lead to poorer household circumstances for their family members (e.g., irregular daily meals, poor nutritional balance, and less time for family-oriented leisure activities at home); therefore, this can result in adverse consequences on husbands' cardiac health. In addition, several findings regarding the distribution of household labor generally suggest that when wives work, it leads to a greater participation of their husbands in the household, increasing relative domestic burden of the husbands [41].

The results of the generalized additive model to nonlinear association suggest a difference in the direction of the association between SWWH <40 hrs and ≥ 40 hrs. We observed a positive association between reduced SWWH (< 40 hrs) and risk of CVD, especially in wives. One possible explanation of the result is that the workers working less than 40 hours per week, which is legal working hours in Korea, may have inferior socioeconomic status and working condition compared to the workers working 40 hours or longer. Those who have short working hours per week are probably precarious workers and non-regular workers in Korea, and they could have relatively larger stress from their position and low income [45]. Moreover, it has been found that couples are more likely to share similar socio-economic backgrounds, and have comparable educational levels, and therefore, are likely to have jobs of similar status, and similar health status. Hence, the observed association between couples may be a consequence of the fact that individuals who are similar to each other are more likely to marry [46,47]. Another explanation may

be possibility of reverse causality. For instance, individuals whose spouses had pre-existing health problems could have reduced their working hours to take care of them. Unfortunately, our cross-sectional study design cannot verify the hypothesized causal ordering about these relationships. Therefore, analysis of longitudinal data would allow further exploration of the questions raised by this study.

There are several limitations to this study that need to be acknowledged. First, our findings are limited by the use of a cross-sectional design. Caution is warranted before definite conclusions for causal relationship between SWWH and the risk of CVD are arrived at. A reverse causation could not be excluded. To minimize these effects, we excluded participants with cerebrovascular or cardiovascular disease in our analysis. Second, lifestyle or family roles may have affected the stress response and eventually the disease development; however, we could not take this fact into consideration due to lack of sufficient information available in our dataset. Finally, since we estimated 10-years risk of CVD by combining six risk factors, participants had to be excluded from the final analytic models even when only one value was missing. However, there were no significant differences in patterns of the relationships when we conducted additional analyses, in which the missing values were treated using multiple imputation technique (S4 Table).

Nevertheless, the present study had the following important strengths. First, it assessed a representative sample of the general population in Korea. Second, to our best knowledge, our study is the first to investigate the crossover effect of spouse long working hours on an individual’s risk of CVD, which can be used as scientific

evidence for stress interventions targeting couple dyads. Third, the stratified analysis by spouse employment status provided a better opportunity to understand the mechanism and identify populations at risk, in order to develop developing practical prevention strategies. Fourth, by using Jee's health-appraisal model that was developed and validated in the Korean population for predicting 10-year risk for CVD, we could accurately predict the risk to identify individuals who are at risk for CVD. Because an individual's risk for future cardiovascular events is modifiable by early interventions, it is important to identify workers who are at risk for CVD in order to prevent the disease early on, using prediction model. In addition, analyzing each component of CVD appraisal model, we observed that SWWH had a close relationship with the risk factors of CVD such as blood pressure, cholesterol levels, diabetes, and smoking habits (S5 Table). In particular, the difference in the prevalence of diabetes in male subjects and that of smoking in female subjects by SWWH categories is outstanding compared to the other risk factors of CVD. Compared to SWWH = 40 hrs and SWWH $\geq$ 80 hrs, the prevalence of diabetes (8.96% vs. 19.80%) showed significant differences among husbands, whereas the SBP (110.96 mmHg vs. 115.33 mmHg), prevalence of diabetes (4.38% vs. 6.22%) and prevalence of current smoking (2.70% vs. 4.82%) showed significant differences among wives. Furthermore, prevalence of diabetes was higher among wives with reduced SWWH. Given that insulin sensitivity and diabetes are known to accelerate development atherosclerosis, this may lead to reversed relationship between SWWH and 10-years risk of CVD among female participants. We hope that these findings also contribute to the proper management

for worker's family as well as themselves.

In conclusion, it is suggested that the spouse's working hours have significant association with the individual's estimated 10-years risk of CVD, especially among husbands. These findings indicate that someone's overtime work is adversely associated not only with their risk of CVD but also that of their spouse. Furthermore, couple's employment status may modify this crossover effect of SWWH on the 10-years risk of CVD. The most important conclusion of this study may be that long working hours is more than a work problem: it seems to be a family problem as well. Therefore, reducing working hours may not only contribute to reducing workers' own cardiac health problems, but also those of their spouses. Our study provides important practical implication that can be helpful for employers and employees seeking work-family balance. In terms of prevention, our results suggest that managerial supports to reduce overtime work may serve a dual purpose of improving health of both employee and their spouse. In addition, providing counselling services and a supportive social environment may help employees retain work–life balance and manage health of themselves and their partners. An intervention study, therefore, is required to establish how these prevention measures would work in practice.

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Supplementary materials

Supplementary TABLE 1. 10-years risk of CVD estimated by Jee's health risk appraisal model according to spouses' working hour categories only among individual aged 30-59.

	Spouse's Working Hours	N	Estimated 10-years risk		≥ 90 percentile of estimated risk of cardiovascular disease			
			Mean	SD	N	%	OR*	95% CI
Husband's 10-year Risk of CVD According Wife's Working Hour Categories	<30	743	1.10	1.01	81	10.90	1.86	1.18-2.93
	30-39	534	1.12	0.95	57	10.67	1.58	0.97-2.57
	40	563	0.96	0.77	36	6.39	1	Reference
	41-49	610	1.10	1.00	61	10.00	1.75	1.09-2.80
	50-59	402	1.18	0.91	45	11.19	1.71	1.04-2.84
	60-69	245	1.30	0.99	32	13.06	2.11	1.22-3.65
	70-79	220	1.41	1.04	37	16.82	2.60	1.52-4.47
	≥80	130	1.60	1.39	25	19.23	3.40	1.84-6.26
	Total	3447	1.05	0.94	374	10.85		
Wife's 10-year Risk of CVD According husband's Working Hour Categories	<30	434	0.34	0.28	94	21.66	1.79	1.08-2.97
	30-39	530	0.23	0.23	49	9.25	1.04	0.60-1.79
	40	1234	0.17	0.20	74	6.00	1	Reference
	41-49	1359	0.19	0.27	101	7.43	1.14	0.72-1.81
	50-59	1355	0.18	0.20	82	6.05	1.00	0.63-1.59
	60-69	881	0.18	0.20	63	7.15	1.09	0.70-1.79
	70-79	521	0.23	0.26	63	12.09	1.26	0.76-2.11
	≥80	287	0.22	0.21	29	10.10	1.55	0.87-2.79
	Total	6601	0.22	0.25	555	8.41		

*adjusted for household income level, education level, employment status, and spouse occupation categories

Supplementary TABLE 2. Odds ratio for high-risk group of 10-years risk of CVD estimated by Jee's health risk appraisal model according to spouses' working hour categories

	Spouse's Working Hours	Model 1[a]		Model 2[b]	
		OR	95% CI	OR	95% CI
Husband's 10-year Risk of CVD According Wife's Working Hour Categories	<30	1.32	0.83-2.09	1.27	0.81-2.03
	30-39	1.29	0.79-2.11	1.26	0.77-2.07
	40	1	Reference	1	Reference
	41-49	1.64	1.15-2.65	1.59	0.98-2.57
	50-59	1.16	0.69-1.94	1.13	0.67-1.90
	60-69	1.71	1.02-2.89	1.71	1.01-2.88
	70-79	1.13	0.62-2.07	1.10	0.60-2.02
	≥80	1.90	1.03-3.51	1.85	1.00-3.43
Wife's 10-year Risk of CVD According husband's Working Hour Categories	<30	3.88	2.42-6.21	3.86	2.41-6.19
	30-39	2.41	1.45-4.03	2.41	1.44-4.02
	40	1	Reference	1	Reference
	41-49	1.69	1.03-2.78	1.69	1.02-2.78
	50-59	1.45	0.87-2.41	1.44	0.86-2.39
	60-69	1.80	1.07-3.02	1.79	1.06-3.00
	70-79	1.67	0.95-2.94	1.66	0.94-2.93
	≥80	2.24	1.19-4.19	2.18	1.16-4.09

[a]adjusted for household income level, education level, and spouse occupation categories
[b]adjusted for household income level, education level, spouse occupation categories, and perceived stress level

Supplementary TABLE 3. Paired interaction of individual' own and spouse' weekly working hours on 10-years risk of CVD and odds ratio for high-risk group

Own working hours	Spouses' working hours	Male			Female		
		n	Mean±SD	OR* (95% CI)	n	Mean±SD	OR* (95% CI)
<40	<40	2524	2.83±2.25	6.87 (1.67-28.30)	3082	0.95±1.12	10.81 (1.47-79-37)
	40	150	1.98±1.69	4.70 (1.05-21.05)	997	0.24±0.36	2.12 (0.27-16.41)
	41-59	514	2.32±1.89	7.75 (1.85-32.41)	2184	0.28±0.57	3.62 (0.49-26.76)
	≥60	289	2.81±2.28	10.25 (2.42-43.37)	1240	0.33±0.72	3.27 (0.44-24.34)
40	<40	1008	1.16±1.12	1.49 (0.35-6.34)	207	0.42±0.69	4.51 (0.56-35.99)
	40	151	1.00±0.85	1 (Reference)	154	0.18±0.30	1 (Reference)
	41-59	171	1.10±0.95	2.15 (0.41-11.34)	254	0.21±0.43	3.57 (0.42-30-13)
	≥60	93	1.45±1.31	3.31 (0.62-17.59)	139	0.26±0.44	2.36 (0.25-22.11)
41-59	<40	2245	1.11±1.61	1.28 (0.31-5.36)	487	0.58±0.77	4.15 (0.55-31.40)
	40	251	0.92±0.78	1.07 (0.19-6.00)	172	0.22±0.34	4.01 (0.45-36.06)
	41-59	529	1.52±1.38	3.00 (0.70-12.77)	528	0.38±0.65	2.94 (0.39-22.48)
	≥60	219	1.75±1.40	2.63 (0.58-12.05)	343	0.38±0.54	4.53 (0.59-34.90)
≥60	<40	1285	1.30±1.39	1.66 (0.40-6.97)	272	0.64±0.74	4.43 (0.58-33.89)
	40	130	1.28±1.19	2.52 (0.50-12.84)	89	0.32±0.42	1.86 (0.16-21.49)
	41-59	328	1.46±1.25	1.68 (0.37-7.75)	225	0.44±0.67	2.88 (0.36-23.12)
	≥60	372	1.78±1.33	2.61 (0.60-11.33)	363	0.49±0.60	4.92 (0.65-37.26)

*adjusted for household income level, educational level, and spouse's occupation categories

Supplementary TABLE 4. 10-year risk of CHD estimated by Jee's appraisal model according to spouse working hour categories including subjects with missing values, which are treated by multiple imputation.

	Spouse's Working Hours	N	10-year risk		≥ 90 percentile of estimated risk of cardiovascular disease			
			Mean	SD	N	%	OR*	95% CI
Husband's 10-year Risk of CVD According Wives' Working Hour Categories	<30	1277	1.77	1.74	116	9.08	1.02	1.02-1.02
	30-39	858	1.68	1.73	74	8.62	1.29	1.29-1.30
	40	779	1.22	1.19	32	4.11	1	Reference
	40-49	925	1.62	1.57	64	6.92	1.40	1.39-1.40
	50-59	666	1.79	1.54	55	8.26	1.45	1.44-1.45
	60-69	435	2.05	1.90	53	12.18	2.01	2.00-202
	70-79	346	1.83	1.31	32	9.25	1.49	1.48-1.49
	≥80	217	2.14	1.73	20	9.22	1.65	1.64-1.66
	Total	5503	1.76	1.79	446	8.10		
Wife's10-year Risk of CVD According husband's Working Hour Categories	<30	872	0.91	1.07	178	20.41	3.48	2.53-4.79
	30-39	795	0.53	0.77	74	9.31	2.84	2.02-3.98
	40	1530	0.25	0.50	28	1.83	1	Reference
	40-49	1748	0.31	0.57	69	3.95	1.82	1.30-2.55
	50-59	1738	0.33	0.60	63	3.62	2.88	2.06-4.02
	60-69	1163	0.33	0.61	54	4.64	1.82	1.26-2.61
	70-79	706	0.43	0.95	35	4.96	1.82	1.26-2.61
	≥80	414	0.43	0.69	26	4.93	2.34	1.58-3.48
	Total	8966	0.54	0.90	527	5.88		

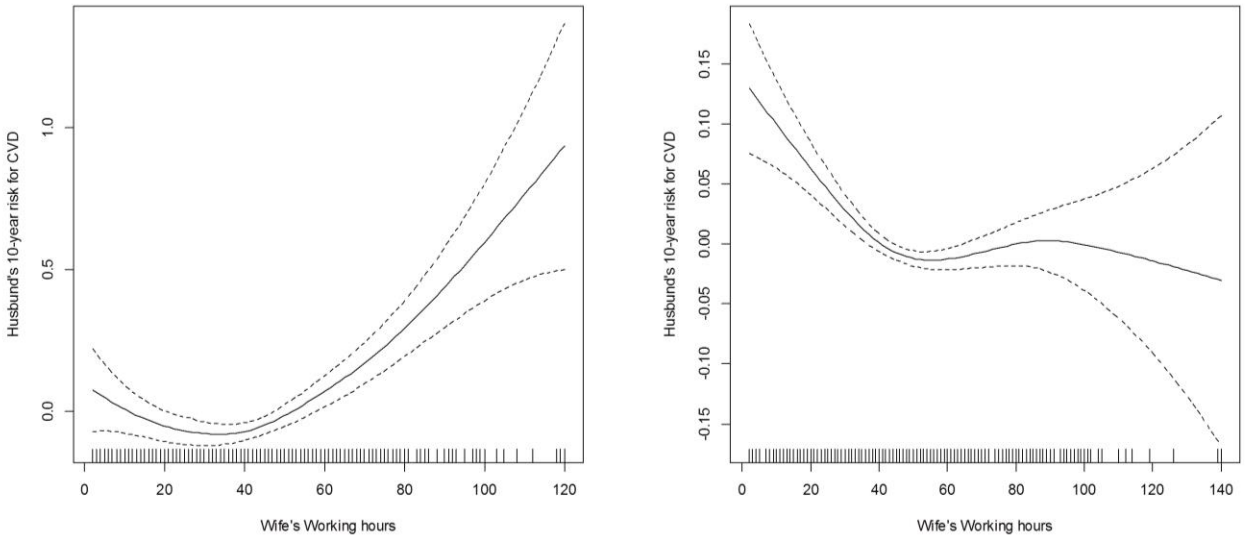
*adjusted for household income level, education level, employment status, and spouse occupation categories

Supplementary TABLE 5. Cardiovascular risk profiles used in Jee's appraisal model according to spouse working hour categories

Spouse's Weekly working hours	SBP		DBP		TC		HDL		DM		Smoking	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	n	%	n	%
Male												
<30	121.25	15.93	79.11	10.84	190.49	35.03	48.62	12.23	119	10.85	473	40.74
30-40	121.28	15.61	79.52	10.58	193.17	34.56	48.99	12.07	67	8.96	357	44.68
40	119.52	15.55	80.31	10.70	191.53	33.93	47.82	10.94	59	8.63	326	45.59
40-50	121.36	15.61	79.43	10.66	192.32	34.04	48.68	12.04	114	14.02	378	44.21
50-60	122.82	16.55	80.19	10.75	189.55	35.42	47.87	11.70	71	11.93	259	41.64
60-70	122.90	16.55	79.61	11.56	190.28	35.22	48.90	12.79	55	14.10	188	46.53
70-80	124.96	17.27	80.36	11.27	190.00	36.64	49.26	12.99	44	14.10	152	46.91
≥80	122.85	16.24	79.31	10.97	186.90	36.98	47.68	11.62	39	19.80	87	41.83
Total	121.66	15.96	79.44	10.66	190.26	34.96	48.07	11.87	568	11.75	2220	43.63
Female												
<30	122.08	18.41	75.69	9.88	197.50	36.61	52.41	13.26	84	10.87	26	3.13
30-40	116.11	18.29	74.04	10.00	192.56	36.47	53.75	12.30	49	6.84	20	2.62
40	110.96	15.21	72.95	9.94	188.62	34.22	55.27	12.54	62	4.38	40	2.70
40-50	112.88	16.60	73.41	9.98	187.83	35.58	54.73	12.59	78	4.89	58	3.46
50-60	112.74	15.70	73.52	9.98	187.86	37.67	54.19	12.72	73	4.55	58	3.45
60-70	113.84	16.49	73.87	9.98	187.47	34.19	53.98	12.22	53	4.97	45	4.03
70-80	115.07	16.71	74.42	10.09	190.25	37.31	53.37	12.33	46	7.04	29	4.26
≥80	115.33	17.24	74.22	10.11	189.96	34.61	53.03	12.74	23	6.22	19	4.82
Total	115.85	17.44	74.13	10.04	190.71	36.31	53.75	12.64	468	5.71	295	3.42

Supplementary FIGURE

Supplementary Figure. Generalized additive model of spouse's working hours and estimated 10-year risk of CVD only among individual aged 30-59



요약(국문초록)

장시간 근로가 배우자의 심혈관질환 발생에 미치는 교차효과분석

배경 및 목적: 그 동안 '과중업무' 또는 '장시간 근로'가 유발하는 근로자의 정신적, 육체적 건강영향에 대한 역학적 근거는 국내외에서 꾸준히 축적되어 왔다. 대표적인 건강 문제로는 뇌심혈관계질환이 있으며, 수면장애 및 우울증 등의 정신건강문제, 소화기 질환, 유방암 등이 장시간 근로의 주요 건강 문제로 언급이 되어 왔다. 그러나 소수의 연구만이 일과 가정의 삶에서의 균형이라는 맥락에서 장시간 근로가 가진 불균형에 대해 문제를 제기하였다. 일부 연구에서 직장내 스트레스의 교차효과(crossover effect)를 살펴보기는 하였으나, 장시간 근로가 배우자에게 끼치는 건강영향은 직접적으로 연구된 바가 없어 그로 인한 영향에 대한 규모와 성격을 파악할 수 없었다. 본 연구의 목적은 한국의 대표성 있는 자료를 이용하여 성인 부부를 대상으로 근로자의 근로시간과 배우자의 심혈관 질환의 발생 위험과의 연관성을 파악하고, 그 영향의 역학적 특성 밝히는 것이다.

연구방법: 국민건강영양조사에서는 가족 단위에 대한 인식번호가 부여되므로,

그 코드와 가족 내 관계를 판단하기 위해 부여된 코드를 이용하여, 동거하는 부부 사이에서 남편과 아내의 관계를 파악하였다. 이를 바탕으로 배우자의 경제활동상태를 판단할 수 있고, 경제활동을 하고 있는 경우 배우자의 근로시간에 대한 정보도 알 수 있었다. 분석 당시 국민건강영양조사 자료는 5기 3차년도인 2012년 자료까지 공개가 되었다. 4기 자료인 2007년~2009년 자료와 5기 자료인 2010~2012년 자료를 모두 함께 병합하여 총 50,405명의 데이터셋을 확보할 수 있었는데, 이 중에서 결혼을 하여 부부가 함께 살고 있는 대상자 24,788명을 포함하고, 그 외 결혼하지 않았거나, 기혼이지만 함께 주거하지 않는 대상자들은 제거하였다. 남은 연구대상자 중에서 과거 심혈관질환이나 뇌혈관질환을 진단 받은 대상자는 분석에 적합하지 않는 것으로 판단되어 추가로 제외하고 적합한 연구대상군으로 총 23,769명(남성 11,742명, 여성 12027명)을 선정하였다. 심혈관질환 위험도평가 지수를 산출하기 위한 변수(나이, 성별, 흡연력, 혈압, 당뇨, 혈중지질수치)가 없는 대상자 3,030명을 추가로 제거한 후 최종적으로 남성 10,030명, 여성 10,709명으로 총 20,739명을 대상으로 분석하였다. 심혈관질환 발생 위험도를 예측하기 위하여 선행 연구에서 타당성에 대해 검토되었던 ‘지선하의 심혈관질환 위험도평가 지수’를 이용하였다. 지선하의 심혈관질환 위험도평가는 심혈관질환의 일차예방을 위해 심혈관질환의 주요 독립적 위험요인인 흡연, 당뇨, 총콜레스테롤, 고밀도지단백 콜레스테롤, 수축기 혈압 및 이완기 혈압과 연령에 따라 남녀별로 점수를 매겨, 각 위험점수의 총합으로 향후 10년 동안 심혈관질환으로 이환될 확률을 절대위험도로

산출하는 방법이다. 이 방법은 다른 위험도 예측도구와 비교하여 몇 가지 장점을 가지고 있는데, 첫째, 즉각적으로 중재를 해야 할 고위험군을 감별해내고, 둘째, 고위험군에게 위험을 감소시키려는 치료에 대한 동기를 부여하고, 셋째, 총위험도평가에 기초하여 치료의 강도를 조정하는데 유용하다는 것이다. 국민건강영양자료에는 연구대상자의 경제활동여부 및 직업에 대한 분류 등에 대한 정보가 조사되었다. 앞선 분석 내용에 더하여, 배우자의 경제활동여부에 따른 심혈관질환 발생위험을 비교해서 분석하였다.

연구결과: 각 연구대상자에 대해 지선하 모형을 이용하여 예측된 심혈관질환 발생 위험점수와 배우자의 근로시간과의 연관성을 살펴보면, 남편의 경우 근로시간이 주당 40시간 정도에서 아내의 심혈관질환 발생위험이 가장 낮은 것으로 나타났고, 근로시간이 증가하면서 그 위험이 점차 증가하는 양상을 보였다. 이러한 양상은 아내의 근로시간과 남편의 심혈관질환 발생위험을 살펴보아도 유사하게 관찰되었으나, 배우자의 주당근로시간이 40시간보다 작은 경우에도 아내의 심혈관질환 발생위험은 두드러지게 증가하는 것으로 드러났다. 10년내 심혈관질환의 발생위험이 상위 10%이상을 고위험군으로 정의하고, 배우자의 근로시간이 40시간인 군을 기준으로 고위험군의 분포를 살펴보았을 때, 배우자의 근로시간이 증가함에 심혈관질환 발생의 고위험군이 될 오즈비가 남성의 경우 최대 1.9배로 증가하였고, 여성의 경우에는 최대 2.24배로 증가하는 것으로 나타났다. 그리고, 이런 근로시간과 배우자의 심혈관질환 발생위험과의 상관관계는 부부의 경제활동여부에 따라서 다른

양상을 보여주었다.

결론: 본 연구결과, 개인의 근로시간과 배우자의 심혈관질환 발생위험은 유의한 연관성이 있었고, 이런 연관성은 부부의 경제활동여부에 따라 다른 양상을 보였다.

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주요어: 장시간근로, 심혈관질환 발생위험, 배우자, 교차효과
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